

**FINAL REPORT
AUGUST 2006**

REPORT NO. 06-03



**40"x44" METAL PALLET WITH METAL
ADAPTERS WITH PA125 METAL BOXES,
MIL-STD-1660 FIRST ARTICLE TESTS**

Distribution Unlimited

Prepared for:

Commander
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**DEFENSE AMMUNITION CENTER
VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053**

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**REPORT NO. 06-03
40" x 48" METAL PALLET WITH METAL ADAPTERS
WITH PA125 METAL BOXES
MIL-STD-1660 FIRST ARTICLE TESTS**

AUGUST 2006

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV) conducted First Article Tests in accordance with MIL-STD-1660, "Design Criteria for Ammunition Unit Loads" on the 40" x 48" metal pallet with metal adapters with PA125 metal boxes manufactured by Choctaw Manufacturing and Development Corporation (CDMC), from Hugo, Oklahoma. Six test units were tested. The test units were loaded and passed with a load of 2,560 lbs each for Test Units #1 and #2 and 2,565 lbs for Test Units #3 through #6. The tests accomplished on Test Units #1, #2 and #3 were the stacking, vibration, drop, incline- impact, sling compatibility, forklift handling, and disassembly tests. Test Units #4, #5 and #6 were stack tested only.

Test Units #1, #2 and #3 sustained minor damage on the welds between the skids and the posts during testing. Test Units #1 and #2 had the middle post break through the deck. All damage was deemed minor in nature and not deemed a cause for failure. As a result of the performance of the 40" x 48" metal pallet with metal adapters with PA125 metal boxes manufactured by Choctaw Manufacturing and Development Corporation (CDMC), from Hugo, Oklahoma is recommended for use by the United States Army.

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**VALIDATION ENGINEERING DIVISION
MCALESTER, OK 74501-9053**

REPORT NO. 06-03

**40" x 48" METAL PALLET WITH METAL ADAPTERS
WITH PA125 METAL BOXES
MIL-STD-1660 FIRST ARTICLE TESTS**

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PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV) conducted First Article Tests in accordance with MIL-STD-1660, "Design Criteria for Ammunition Unit Loads" on the 40" x 48" metal pallet with metal adapters with PA125 metal boxes manufactured by Choctaw Manufacturing and Development Corporation (CDMC), from Hugo, Oklahoma. Six test units were tested. The test units were loaded and passed with a load of 2,565 lbs each. The tests accomplished on Test Units #1, #2 and #3 were the stacking, vibration, drop, incline-impact, sling compatibility, forklift handling, and disassembly tests. Test Units #4, #5 and #6 were stack tested only. The unitization procedures were provided by DAC, Transportation Engineering Division (SJMAC-DET).

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation
2. OSC-R, 10-23, Mission and Major Functions of the U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

C. OBJECTIVE. The objective of the tests was to determine if the 40" x 48" metal pallet with metal adapters with PA125 metal boxes met the MIL-STD-1660 test requirements prior to the acceptance of the unitization procedures by the U.S. Army.

D. CONCLUSION. As a result of the performance of the container, the 40" x 48" metal pallet with metal adapters with PA125 metal boxes manufactured by Choctaw Manufacturing and Development Corporation (CDMC), from Hugo, Oklahoma is recommended for use by the United States Army.

PART 2 - ATTENDEES

DATE PERFORMED:

Test Unit #1- 11 July 2006
Test Unit #2- 11 July 2006
Test Unit #3- 11-12 July 2006
Test Unit #4- 12 July 2006
Test Unit #5- 12 July 2006
Test Unit #6- 12 July 2006

ATTENDEES

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PART 3 - TEST PROCEDURES

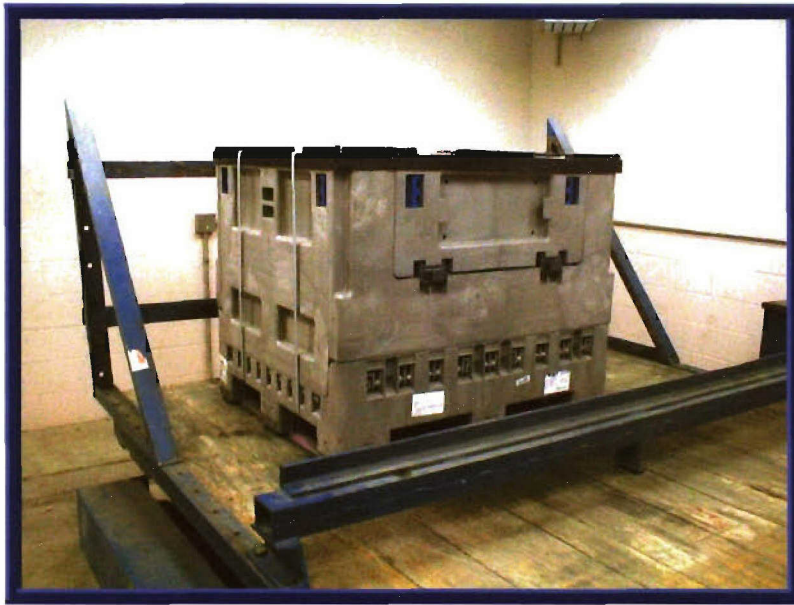
The test procedures outlined in this section were extracted from the MIL-STD-1660, "Design Criteria for Ammunition Unit Loads," 8 April 1977. This standard identifies steps that a unitized load must undergo if it is to be considered acceptable. The seven tests normally conducted on the test specimen are summarized below.

A. STACKING TEST. The specimen will be tested to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load will be simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. Photo 1 below shows an example of a unit load in the compression tester.



**Photo 1. Example of Compression Tester.
(2.75-inch Hydra 70, PA151 Rocket Pallet in the compression tester.)**

B. REPETITIVE SHOCK TEST. The repetitive shock test is conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen will be placed on (not fastened to) the platform. With the load in one position, the platform will be vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles-per-second. The frequency will be steadily increased until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle. Midway into the testing period, the specimen will be rotated 90 degrees, and the test continued for the duration. Unless failure occurred, the total time of vibration will be three hours. Photo 2 shows an example of the repetitive shock test.



**Photo 2. Example of the Repetitive Shock Test.
(Plastic Gemini Pallet Box)**

C. EDGEWISE-ROTATIONAL DROP TEST. This test is conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise-rotational drop test is as follows: The specimen will be placed on its skids with one end of the pallet supported on a beam 6 inches high. The height of the beam will be increased as necessary to ensure that there is no support for the skids between the ends of the specimen when dropping takes place, but was not high enough to cause the specimen to slide on the supports when the dropped end is raised for the drop. The unsupported end of the specimen is then raised and allowed to fall freely to the concrete, pavement, or similar unyielding surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

GROSS WEIGHT (WITHIN RANGE LIMITS) (Pounds)	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) (Inches)	HEIGHT OF DROPS ON EDGES	
		Level A (Inches)	Level B (Inches)
150-250	60-66	36	27
250-400	66-72	32	24
400-600	72-80	28	21
600-1,000	80-95	24	18
1,000-1,500	95-114	20	16
1,500-2,000	114-144	17	14
2,000-3,000	Above 145- No limited	15	12
Above – 3,000		12	9



**Photo 3. Example of Edgewise Rotational Drop Test
(Plastic XYTEC 4845 Pallet Box)**

D. INCLINE-IMPACT TEST. This test is conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen is placed on the carriage with the surface or edge to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage will be brought to a predetermined position on the incline and released. If it were desired to concentrate the impact on any particular position on the container, a 4- x 4-inch timber may be attached to the bumper in the desired position before the test. The carriage struck no part of the timber. The position of the container on the carriage and the sequence in which surfaces and edges were subjected to impacts may be at the option of the testing activity and dependent upon the objective of the test. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen will be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at the time of the impact was 7 feet-per-second. Photo 4 shows an example of this test.



Photo 4. Example of the Incline-Impact Test.
(2.75-Inch, Hydra 70, PA151 Rocket Pallet on incline-impact tester.)

E. FORKLIFTING TESTS. The specimen shall be lifted clear of the ground by a forklift from the end of the specimen and transported on the forks in the level or back-tilt position across a hard pavement for a distance of not less than 100 feet. The forklift will pass over the forklift hazard course as outlined in MIL-STD-1660. The hazard course will consist of parallel pairs of 1-inch boards spaced 54 inches apart and will be laid flatwise on the pavement across the path of the forklift. The first pair will be placed securely across the forklift's path and centered 30 feet from the starting point; the second pair will be laid 60 feet from the starting point at an angle of approximately 60 degrees to the path so the first wheel strikes first; and the third pair will be laid 90 feet from the starting point approximately 75 degrees to the path so the right wheel strikes first. The forklift will pass over the forklift hazard course 2 times in approximately 23 seconds, and then be brought to a stop. The load shall be observed for deflection and damage. The specimen will be rotated 90 degrees and the load lifted from the side and the above steps repeated.

F. SLING COMPATIBILITY TEST. The specimen utilizing special design or non-standard pallets will be lifted, swung, lowered and otherwise handled as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings will be easily attached and removed. Danger of slippage or disengagement when load is suspended will be cause for rejection of the specimen.

G. DISASSEMBLY TEST. Following all rough handling tests the specimen may be squared up within 2 inches of its original shape and on a flat level surface. The strapping will then be cut and removed from the palletized load. Assembly of the load will be such that it retains its unity upon removal of the strapping.

PART 4 - TEST EQUIPMENT

A. COMPRESSION TESTER.

1. Nomenclature	Compression Table
2. Manufacturer:	Ormond Manufacturing
3. Platform:	60- by 60-inches
4. Compression Limit:	50,000 pounds
5. Tension Limit:	50,000 pounds

B. TRANSPORTATION (REPETITIVE SHOCK)SIMULATOR.

1. Nomenclature	Repetitive Shock Simulator
2. Manufacturer:	Gaynes Laboratory
3. Capacity:	6,000-pound payload
4. Displacement:	1/2-inch amplitude
5. Speed:	50 to 400 RPM
5. Platform:	5- by 8-foot

C. INCLINED PLANE.

1. Nomenclature	Incline Plane Impact Tester
2. Manufacturer:	Conbur Incline
3. Type:	Impact Tester
4. Grade:	10 percent incline
5. Length:	12-foot

PART 5 - TEST RESULTS

A. CONTAINER DATA. The test units were inertly loaded to the specified design weight. Special care was taken to ensure that each individual interior ammunition container had the proper amount of weight in order to achieve a realistic pallet center of gravity (CG). Once properly prepared, the test unit was tested using MIL-STD-1660, "Design Criteria for Ammunition Unit Loads," requirements. Photo 5 shows the test unit loaded.



Photo 5. Loaded Test Unit.

TEST UNIT #1:

Test Date: 11 July 2006

Weight: 2,560 pounds

Length: 44-13/16 inches

Width: 40-3/4 inches

Height: 33-5/8 inches

Container inertly loaded with:

42 PA125 Boxes loaded to 55 pounds each with sand, gravel and scrap metal

TEST UNIT #2:

Test Date: 11 July 2006
Weight: 2,560 pounds
Length: 44-13/16 inches
Width: 40-3/4 inches
Height: 33-5/8 inches

Container inertly loaded with:
42 PA125 Boxes loaded to 55
pounds each with sand, gravel
and scrap metal

TEST UNIT #3:

Test Date: 11-12 July 2006
Weight: 2,565 pounds
Length: 44-13/16 inches
Width: 40-3/4 inches
Height: 33-5/8 inches

Container inertly loaded with:
42 PA125 Boxes loaded to 55
pounds each with sand, gravel
and scrap metal

TEST UNIT #4:

Test Date: 12 July 2006
Weight: 2,565 pounds
Length: 44-13/16 inches
Width: 40-3/4 inches
Height: 33-5/8 inches

Container inertly loaded with:
42 PA125 Boxes loaded to 55
pounds each with sand, gravel
and scrap metal

TEST UNIT #5:

Test Date: 12 July 2006
Weight: 2,565 pounds
Length: 44-13/16 inches
Width: 40-3/4 inches
Height: 33-5/8 inches

Container inertly loaded with:
42 PA125 Boxes loaded to 55
pounds each with sand, gravel
and scrap metal

TEST UNIT #6:

Test Date: 12 July 2006

Weight: 2,565 pounds

Length: 44-13/16 inches

Width: 40-3/4 inches

Height: 33-5/8 inches

Container inertly loaded with:

42 PA125 Boxes loaded to 55 pounds each with sand, gravel and scrap metal

B. TEST RESULTS of TEST UNIT #1:

1. **COMPRESSION TEST.** Test Unit #1 was compressed with a load force of 12,800 pounds for 60 minutes on 11 July 2006. There was no damage noted to the test unit as a result of this test. See Photo 6 below for a typical picture of the test unit in the compression tester.

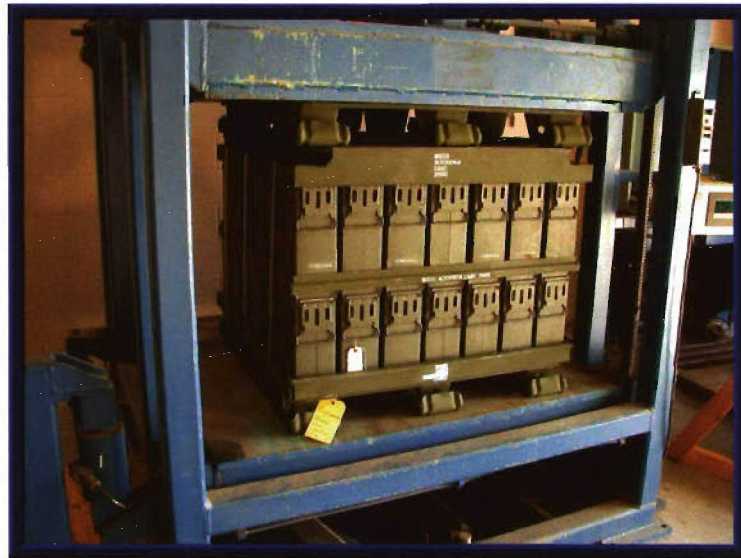


Photo 6. Test Setup for Compression Testing.

2. **REPETITIVE SHOCK TEST.** Test Unit #1 was vibrated 90 minutes at 220 RPM in the longitudinal orientation and 90 minutes at 205 RPM in the lateral orientation on 11 July 2006. Minor damage was noted on the welds between the

skids and the posts and the bottom of the pallet deck. No significant damage was noted during this test. See Photo 7 for the test setup for the vibration test.



Photo 7. Test Setup for Vibration Tests.

3. EDGEWISE-ROTATIONAL DROP TEST. Test Unit #1 was edgewise-rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. No damage was noted during this test. See Photo 8 for the test setup for the drop tests.



Photo 8. Test Setup for Drop Testing.

4. INCLINE-IMPACT TEST. Test Unit #1 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered. See Photo 9 for test setup for incline-impact testing.



Photo 9. Test Setup for Incline-Impact Testing.

5. **FORKLIFTING TEST.** Test Unit #1 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage nor instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered. See Photo 10 for the test setup during the forklift test.



Photo 10. Test Setup for Forklifting Testing.

6. **SLING COMPATIBILITY TEST.** Test Unit #1 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top assembly. No problems were encountered during the lifts. See Photo 11 for the test setup during the sling compatibility test.



Photo 11. Test Setup for Sling Compatibility Testing.

7. **DISASSEMBLY TEST.** During the disassembly of Test Unit #1 no additional problems were noted.

8. **CONCLUSION.** Test Unit #1 passed all required tests.

C. TEST RESULTS of TEST UNIT #2:

1. **COMPRESSION TEST.** Test Unit #2 was compressed with a load force of **12,800** pounds for 60 minutes on 11 July 2006. No damage was noted as a result of this test.

2. **REPETITIVE SHOCK TEST.** Test Unit #2 was vibrated 90 minutes at **220** RPM in the longitudinal orientation and **205** RPM in the lateral orientation. Minor weld damage was noted between the posts and the bottom of the deck. No significant damage was noted as a result of this test.

3. **EDGEWISE-ROTATIONAL DROP TEST.** Test Unit #2 was edgewise-rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. Minor damage was noted on the welds between the posts and skids and the posts and the bottom of the pallet deck. No significant damage was noted from this test.

4. **INCLINE-IMPACT TEST.** Test Unit #2 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered.

5. **FORKLIFTING TEST.** Test Unit #2 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage nor instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered.

6. **SLING COMPATIBILITY TEST.** Test Unit #2 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top adapter. No problems were encountered during the lifts.

7. **DISASSEMBLY TEST.** During the disassembly of Test Unit #2 it was noted that the middle posts had broken through the top of the deck. See Photos 12 and 13 for the damage noted. No significant damage was noted from this test.

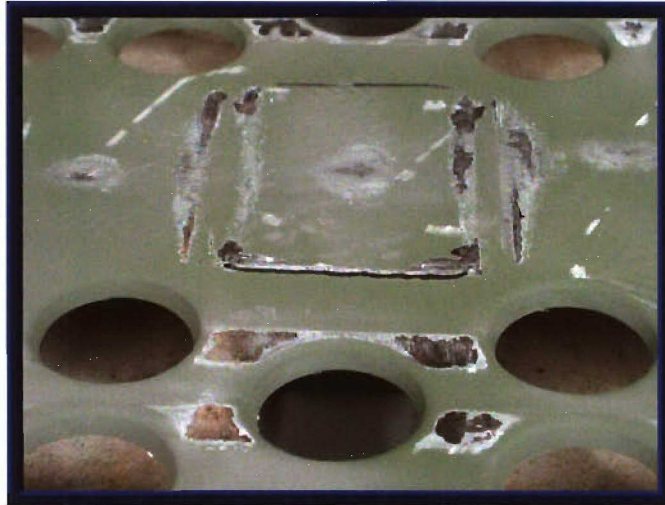


Photo 12. Damage Noted During Disassembly Test.



Photo 13. Damage Noted During Disassembly Test.

8. CONCLUSION. Test Unit #2 passed all required tests.

D. TEST RESULTS of TEST UNIT #3:

1. COMPRESSION TEST. Test Unit #3 was compressed with a load force of 12,800 pounds for 60 minutes on 11 July 2006. No damage was noted as a result of this test.

2. **REPETITIVE SHOCK TEST.** Test Unit #3 was vibrated 90 minutes at 220 RPM in the longitudinal orientation and 205 RPM in the lateral orientation. No significant damage was noted as a result of this test.

3. **EDGEWISE-ROTATIONAL DROP TEST.** Test Unit #3 was edgewise rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. Minor damage was noted on the welds between the posts and skids and the post and the bottom of the pallet deck. No significant damage was noted from this test.

4. **INCLINE-IMPACT TEST.** Test Unit #3 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered.

5. **FORKLIFTING TEST.** Test Unit #3 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage nor instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered.

6. **SLING COMPATIBILITY TEST.** Test Unit #3 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top adapter. No problems were encountered during the lifts.

7. **DISASSEMBLY TEST.** During the disassembly of Test Unit #3 it was noted that the middle posts had broken through the top of the deck just as it had for Test Unit #2. See Photo 14 for the damage noted. No significant damage was noted from this test.

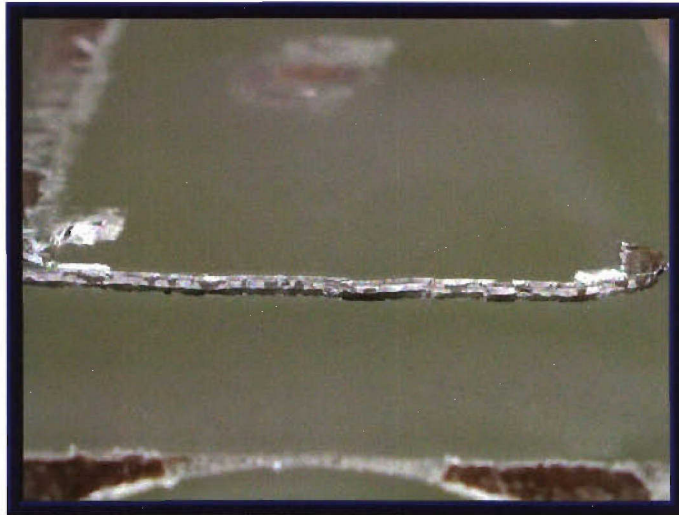


Photo 14. Damage Noted During Disassembly Test.

8. **CONCLUSION.** Test Unit #3 passed all required tests.

E. TEST RESULTS of TEST UNIT #4:

COMPRESSION TEST. Test Unit #4 was compressed with a load force of 12,800 pounds for 60 minutes on 12 July 2006. No damage was noted as a result of this test.

F. TEST RESULTS of TEST UNIT #5:

COMPRESSION TEST. Test Unit #5 was compressed with a load force of 12,800 pounds for 60 minutes on 12 July 2006. No damage was noted as a result of this test.

G. TEST RESULTS of TEST UNIT #6:

COMPRESSION TEST. Test Unit #6 was compressed with a load force of 12,800 pounds for 60 minutes on 12 July 2006. No damage was noted as a result of this test.

PART 6– DRAWINGS

The following test sketches represent the load configuration that was subjected to the test criteria.

APPENDIX 17

UNITIZATION PROCEDURES FOR AMMUNITION AND COMPONENTS PACKED IN METAL OR PLASTIC BOXES ON 4-WAY ENTRY PALLETS

CARTRIDGE, 25MM, PACKED 30 PER PA125 METAL BOX, UNITIZED 42 PER 44" X 40" PALLET;
APPROX CONTAINER SIZE 14-5/16" L X 5-3/4" W
X 13-7/8" H

NOTICE: THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4232-20PM1007.

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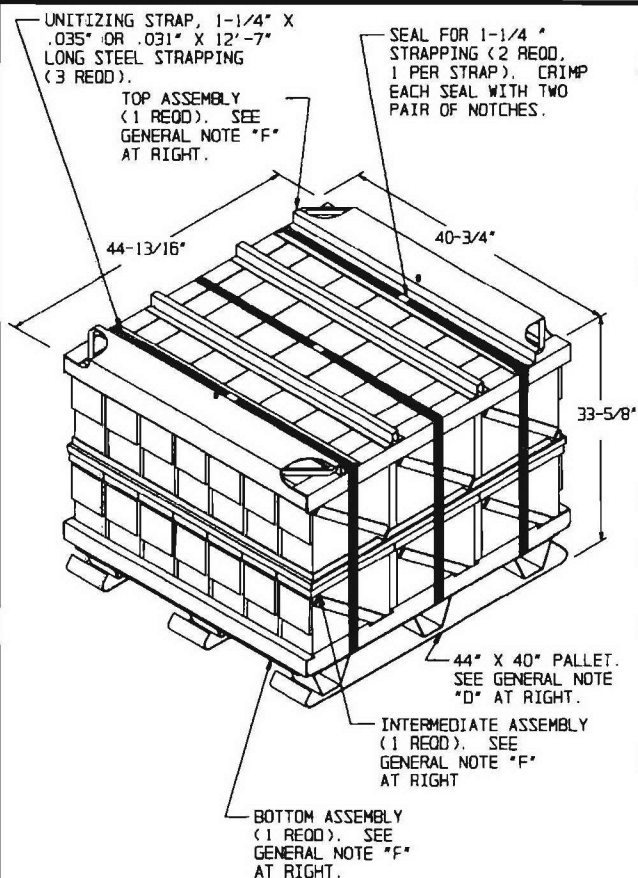
PALLET UNIT DATA				
ITEMS INCLUDED		HAZARD CLASS AND DIVISION •		APPROX WEIGHT LBS
NSN	DODIC	DD CLASS	COMP GROUP	
1305-				
01-350-5265	A940	1.2	C	2,467
01-348-0192	A986	1.2	C	2,467
01-356-0187	A967	---	INERT	2,551
01-356-0188	A975	1.2	E	2,551
01-356-0189	A976	1.2	C	2,551
01-356-9838	A974	1.2	C	2,467

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REVISION

REVISION NO. 1, DATED JUNE 1996, CONSISTS OF, CHANGES PER ECP M6S3023:

1. CHANGING BOX DIMENSIONS AND WEIGHT.
2. ADDING ITEMS BY NATIONAL STOCK NUMBER (NSN) TO "PALLET UNIT DATA" CHART.
3. CHANGING GENERAL NOTES.
4. ADD 3RD STRAP.
5. DELETING GENERAL NOTE RELATING TO STRAP CUTTER AND RE-LETTERING OTHER GENERAL NOTES.



GENERAL NOTES

- THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4232-20PM1007. TO PRODUCE AN APPROVED UNIT LOAD, ALL PERTINENT PROCEDURES, SPECIFICATIONS AND CRITERIA SET FORTH WITHIN THE BASIC DRAWING WILL APPLY TO THE PROCEDURES DELINEATED IN THIS APPENDIX.
- DIMENSIONS, CUBE AND WEIGHT OF A PALLET UNIT WILL VARY SLIGHTLY DEPENDING UPON THE ACTUAL DIMENSIONS OF THE BOX AND THE WEIGHT OF THE SPECIFIC ITEM BEING UNITIZED.
- THE FOLLOWING AMC DRAWINGS ARE APPLICABLE FOR OUTLOADING AND STORAGE OF THE ITEMS COVERED BY THIS APPENDIX.

CARLOADING	-----	DRAWING 19-48-4246/17-5PM1005.
TRUCKLOADING	-----	DRAWING 19-48-4247/17-11PM1005.
STORAGE	-----	DRAWING 19-48-4251/17-1-2-3-4-14-22PM1005.
MILVAN	-----	DRAWING 19-48-4248/17-15PM1010.
END OPENING ISO CONTAINER	-----	DRAWING 19-48-4249/17-15PM1011.
SIDE OPENING ISO CONTAINER	-----	DRAWING 19-48-4271/17-15PM1015.
- FOR DETAILS OF THE PALLET AND PALLET ADAPTER, SEE AMCCOM DRAWING ACV00053, MIL-A-7078B AND MIL-P-70786.
- IF ITEMS COVERED HEREIN ARE UNITIZED PRIOR TO ISSUANCE OF THIS APPENDIX, THE BOXES NEED NOT BE REUNITIZED SOLELY TO CONFORM TO THIS APPENDIX.
- THE UNITIZATION PROCEDURES DEPICTED HEREIN MAY ALSO BE USED FOR UNITIZING PA125 METAL BOXES WHEN IDENTIFIED BY DIFFERENT NATIONAL STOCK NUMBERS (NSN) THAN WHAT IS SHOWN ON PAGE 2, PROVIDED THE BOX PACK DOES NOT VARY FROM WHAT IS DELINEATED HEREIN. THE EXPLOSIVE CLASSIFICATION OF OTHER ITEMS MAY BE DIFFERENT THAN WHAT IS SHOWN.
- EMPTY OR REJECT PA125 BOXES WILL BE USED AS FILLER BOXES AS NECESSARY. FILLER BOXES MUST BE INSTALLED IN THE MIDDLE OF THE TOP LAYER OF BOXES. WHEN (EMPTY) FILLER BOXES ARE USED IN PLACE OF OMITTED BOXES TO COMPLETE A LAYER ON A PALLET, THEY WILL BE MARKED AS SPECIFIED WITHIN MIL-STD-129-1.

PALLET UNIT

SEE GENERAL NOTE "B" AT RIGHT.

42 BOXES OF 25MM CTG (30 PER BOX) AT 55 LBS - 2,310 LBS (APPROX)
 DUNNAGE ----- 136 LBS
 PALLET ----- 105 LBS

TOTAL WEIGHT ----- 2,551 (APPROX)
 CUBE ----- 35.5 CU FT (APPROX)

BILL OF MATERIAL

METAL PALLET, 44" X 40"	1 REOD	105 LBS
TOP ASSEMBLY	1 REOD	80 LBS
INTERMEDIATE ASSEMBLY	1 REOD	15 LBS
BOTTOM ASSEMBLY	1 REOD	35 LBS
STEEL STRAPPING, 1-1/4"	37.75' REOD	5.72 LBS
SEAL FOR 1-1/4" STRAPPING	3 REOD	NIL

